Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Aviation Occurrence Report – 200600633
Final

Runway separation event – Perth Airport – 24 January 2006

VH-VXR

Boeing Company 737-838

VH-NJN

British Aerospace Plc BAe 146-300

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Perth Aerodrome chart courtesy of Airservices Australia.

Abstract

On 24 January 2006 at 0644 Western Standard Time, a Boeing Company 737-800 (737) aircraft, registered VH-VXR, was lined up on the threshold of runway 06 at Perth Airport, WA, when the aerodrome controller (ADC) issued the crew a clearance for the aircraft to take off. The crew reported that at about the same time, a British Aerospace Plc 146-300 (146) aircraft, registered VH-NJN, crossed runway 06 in the vicinity of taxiway Charlie. The 737 copilot, the non-flying pilot, advised the ADC that '…we'll just wait for the 146 crossing the runway'. The crew delayed the aircraft's takeoff until the 146 had vacated and was taxiing away from the runway.

The ADC and Coordination controller considered that a runway separation standard would exist prior to the 737 commencing takeoff. The 737 crew reported that they were concerned at the taxi speed of the 146 and delayed the commencement of their takeoff until it had vacated the runway.

The incident highlighted the use of a Manual of Air Traffic Services (MATS) procedure for a situation for which it was not designed. The use of the adapted procedure by controllers has possibly reduced safety when used for runway crossing situations.

As an outcome from the investigation Airservices Australia has advised the Australian Transport Safety Bureau that it intends to:

- review the use of take off/landing clearance procedures during runway crossing situations, by aircraft and vehicles
- review runway crossing procedures with a view to assessing the need for a specific runway standard for situations involving aircraft or vehicles crossing a runway during landing/take-off operations
- review the use of memory prompts or aids by tower controllers in situations involving aircraft taxiing across a runway during landing/take-off operations.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau is pleased to report positive safety action in its final reports rather than make formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

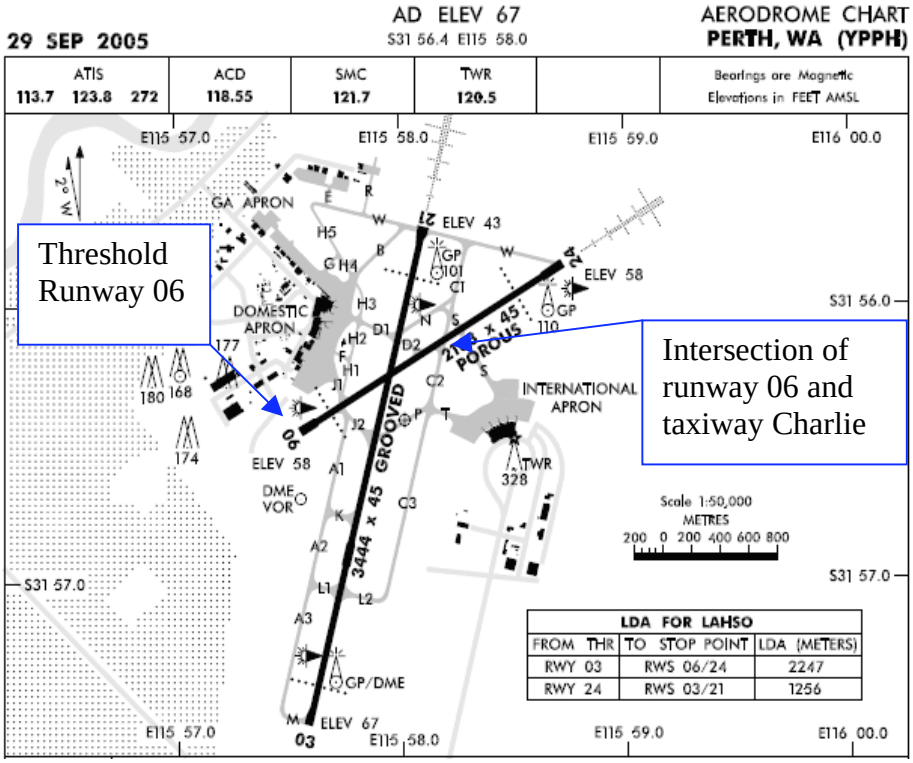
The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

FACTUAL INFORMATION[1]

Sequence of events

On 24 January 2006 at 0644 Western Standard Time[2], a Boeing Company 737-800 (737) aircraft, registered VH-VXR, was lined up on the threshold of runway 06 at Perth Airport, WA, when the aerodrome controller (ADC) issued the crew a clearance for the aircraft to take off. The crew reported that at about the same time, a British Aerospace Plc 146-300 (146) aircraft, registered VH-NJN, crossed runway 06 in the vicinity of taxiway Charlie. The 737 copilot, the non-flying pilot, advised the ADC that '…we'll just wait for the 146 crossing the runway'. The crew delayed the aircraft's takeoff until the 146 had vacated and was taxiing away from the runway.

Figure 1: Perth Aerodrome chart



Not to be used for navigation purposes.

1 Only those investigation areas identified by the headings and subheadings were considered to be relevant to the circumstances of the incident.

2 The 24-hour clock is used in this report to describe the local time of day, Western Standard Time (WST), as particular events occurred. Western Standard Time was Coordinated Universal Time (UTC) + 8 hours.

A review of the Perth Tower air traffic control automatic voice recording showed that at 0622:30, the surface movement controller (SMC) instructed the 737 crew to taxi from the terminal to the holding point at taxiway Juliet 1, which led to the threshold of runway 06. At 0637:31, the SMC instructed the 146 crew to taxi to taxiway Delta. At 0639, the SMC instructed the 146 crew to turn left into taxiway Delta and to hold short of runway 03. At 0640:30, the SMC instructed the 146 crew to cross runway 03, taxi via taxiway November, and to hold short of runway 06 on taxiway November. The crew of the 146 read back '…hold short 03 on November'. The SMC did not query the crew to correct the readback of the issued clearance, that is, to hold short of runway 06. At 0642:20, the ADC instructed the 737 crew to enter runway 06, to line up and to wait. At 0642:52, the SMC instructed the 146 crew to turn hard right into taxiway Charlie, to cross runway 06 and to continue taxiing to the holding point at taxiway Lima. At 0643:53, the SMC advised the 146 crew '…the 737 on 06 will wait for you'. At 0644:20, the 737 copilot acknowledged the takeoff clearance from the ADC and that they would wait for the 146 to cross.

Perth control tower

The tower was staffed by three controllers: an ADC, an SMC and a Coordination controller (Coord). The ADC and SMC were operating on separate radio frequencies. The SMC reported that he was annotating flight progress strips at the time the copilot of the 737 advised that they would wait and did not see the 146 crossing runway 06. The ADC and Coord reported that at that time the takeoff clearance was issued to the 737, the 146 was either on or near the runway 06 centreline and vacating the runway in a southerly direction via taxiway Charlie, and both controllers considered that a runway separation standard would exist prior to the 737 commencing takeoff.

The traffic situation at the time was busy and complex with aircraft having to queue prior to departure. A queue of aircraft, awaiting departure from runway 06, prevented other aircraft from crossing that runway via taxiway Juliet and taxiing to the threshold of runway 03 via taxiway Alpha. The ADC and SMC coordinated the use of a taxiway Lima 2 intersection departure to runway 03 for three 146 aircraft in an endeavour to minimise the delay to departure of those aircraft.

The ADC did not use any tools to remind him that he had approved the SMC to instruct the 146 to cross runway 06 while the 737 was lined up on the threshold, nor was he required to. The ADC reported that such approvals were part of the role of a controller and it was standard practice to rely on memory when such an approval had been provided.

During stressful and high workload situations it is common for a person's attention to narrow and to focus on the most urgent tasks while less urgent, but not necessarily less important tasks may be forgotten. It is common practice for individuals undertaking tasks that require close attention to use checklists or other means to assist them in recalling important actions or tasks.

Perth Airport configuration

The bearing of runway 06 is 061 degrees M. The intersection of taxiway Charlie and runway 06 is midway along that runway, about 1100 m from the runway threshold.

Perth Airport does not have surface movement radar or video surveillance recordings that might have been used to confirm the position of the 146 at the time the takeoff clearance was issued to the 737 crew at 0644:12.

There were no viewing impediments to either the controllers or the pilots from their respective locations.

Take-off clearances

The ADC reported that he issued the take-off clearance to the 737 crew, anticipating that the 146 would have vacated and would be taxiing away from the runway by the time the 737 commenced takeoff. The Manual of Air Traffic Services (MATS) 6.3.8.14, Issuing a Take Off Clearance, stated that:

> Take off clearance may be issued to an aircraft when there is reasonable assurance that the required runway separation will exist when the aircraft commences take off.

The MATS Section 4.8.9, Runway Separation Standards, stated that a departing aircraft shall not be permitted to commence take off until a preceding landing aircraft has vacated and is taxiing away from the runway. A similar standard applies to aircraft taking off or landing on an intersecting runway, in that, a departing aircraft shall not be permitted to commence takeoff until a preceding departing aircraft has crossed the intersection or a preceding landing aircraft (on the intersecting runway) has either crossed or stopped short of the intersection. The MATS 6.3.1, Aerodrome Clearances – General also requires a controller to visually check a runway to ensure there are no obstruction before issuing a clearance for takeoff/landing and immediately before a takeoff is commenced or an aircraft crosses the threshold on landing. The MATS 6.3.1.7 states that:

> The clearance [to takeoff or land] shall be withheld or cancelled until an obstruction no longer exists unless in the opinion of the controller:
>
> a. no collision risk exists; and
>
> b. there is reasonable assurance that separation will exist when
>
> 1. the aircraft commences take-off roll; or
>
> 2. the aircraft crosses the runway threshold to land.

The MATS does not have a standard for aircraft taxiing across, or vehicles moving across a runway with an aircraft departing from that runway. The Civil Aviation Safety Authority's Manual of Standards (MOS) for Air Traffic Services does not detail the take-off clearance procedure as it is not a standard.

The International Civil Aviation Organization (ICAO) Doc 4444 (ATM/501), Procedures for Navigation Services - Air Traffic Management details a similar procedure and stated that:

7.8.3.1 Take-off clearance may be issued to an aircraft when there is reasonable assurance that the separation in 7.8.2, or prescribed in accordance with 7.10, will exist when the aircraft commences take-off.

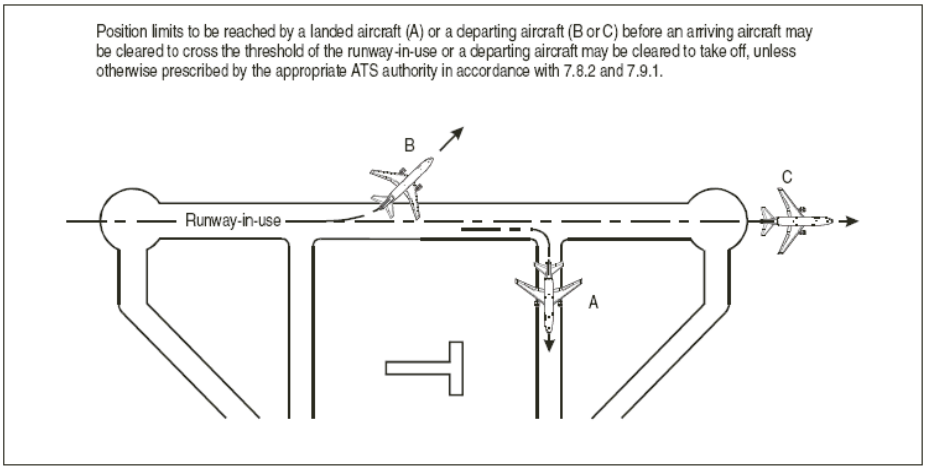


Figure 7-3. Separation between departing and arriving aircraft (see 7.8.2 and 7.9.1)

Section 7.8.2, Separation of departing aircraft stated that:

> Except as provided in 7.10 and Chapter 5, Section 5.8, a departing aircraft will not normally be permitted to commence take-off until the preceding departing aircraft has crossed the end of the runway-in-use or has started a turn or until all preceding landing aircraft are clear of the runway-in-use.

Section 7.10 details requirements for the application of reduced runway separation minima between aircraft using the same runway. They include a requirement for a documented safety assessment and consultation with operators. It limits the use of any reduced minima to daylight hours (30 minutes after local sunrise to 30 minutes before local sunset). Section 5.8 details wake turbulence longitudinal separation minima. The ICAO Doc 4444 does not have a standard for aircraft or vehicles crossing a runway with an aircraft departing or landing on that runway.

Section 7.8.3.1 of ICAO Doc 4444 applies specifically to circumstances where an aircraft is becoming airborne from the runway, or landing and vacating the runway. In each of these circumstances, the pilot of the preceding aircraft would be operating on the ADC frequency until a separation standard positively exists. The MATS section 6.3.8.14 places no limitations on the circumstances in which controllers may issue a clearance in anticipation of a clearance existing when the cleared aircraft commences its take-off roll. The use of the MATS procedure for aircraft crossing a runway with an aircraft taking off means that the pilots of the aircraft involved are operating on different radio frequencies.

Annex 11 to the Convention on International Civil Aviation - Air Traffic Services, Doc 4444 and MATS do not define ‘reasonable assurance’. The Macquarie Dictionary defines ‘reasonable’ as ‘endowed with reason’ and ‘assurance’ as ‘full confidence or trust; freedom from doubt; certainty’. The controllers reported that they expected up to a 30 to 60 second delay between issuing a take-off clearance and an aircraft commencing takeoff. Both the Doc 4444 and the MATS do not detail how controllers are to achieve reasonable assurance in the application of the procedure.

Separation standards and separation assurance

The MATS Section 1 - Separation Standards states that 'separation shall be provided by ATC using approved separation standards and procedures to ensure the spacing between the positions of aircraft is never less than a prescribed minimum'. It then advises that the use of separation assurance 'is an integral part of the application of a systemic approach to the safety management system' and that 'in order for separation assurance to be effective it must be applied in both the tactical and strategic environments'. The MATS advised that the:

> use of tactical separation assurance places greater emphasis on traffic planning and conflict avoidance rather than conflict resolution. This is achieved through:
>
> a. the proactive application of separation standards to avoid rather than resolve conflicts;
>
> b. planning traffic to guarantee rather than achieve separation;
>
> c. executing the plan so as to guarantee separation; and
>
> d. monitoring the situation to ensure that plan and execution are effective.

The MATS also advises that safety is the priority and expedition is secondary to the absolute requirement for safety.

737 crew

The 737 crew reported that the 146 was outside of, or near the runway gable markers approaching runway 06 when they were issued a take-off clearance. They were concerned at the taxi speed of the 146 and did not think it would be able to stop at the gable markers for runway 06. They monitored that aircraft's approach to the runway, and delayed the commencement of their takeoff until it had vacated the runway.

Weather conditions

The weather was reported to be 'fine' with no cloud and visibility in excess of 10 km. Sunrise was at 0534. The azimuth and elevation of the sun at the time of the incident was 106 degrees 38 minutes M and about 13.5 degrees respectively.

Local safety forum

On 9 June 2005, Perth Airport implemented a Runway Incursion Review Group that included air traffic control and airline representatives. That group has met regularly since that time to address concerns with runway incursions and has developed a diagram of the location of runway incursions. The diagram is available from the Airservices Australia website[3] . There are no prior runway incursions for the intersection of runway 06 with taxiway Charlie on the diagram.

3 See http://www.airservices.gov.au/pilotcentre/training/runwaysafety/incursions/Perth.pdf .

ANALYSIS

The weather and position of the sun were considered not to be factors in the incident.

The account of the incident provided by the controllers in the tower and by the 737 crew indicated they were all aware of the taxiing 146. Perth Airport has no ground radar or other video surveillance that would enable determination of the precise position of the aircraft at the time radio transmissions were made. The inability to establish the position of the 146 relative to the timing of radio transmissions prevented the investigation reconciling the different perceptions of the circumstances of the incident provided by the controllers and the 737 crew.

While the incident as reported could not be confirmed or refuted, it highlighted the use of a procedure for a situation for which it was not designed. In the absence of a standard for aircraft taxiing across a runway with an aircraft departing from that runway, it appears that controllers have adapted Manual of Air Traffic Services (MATS) Runway Separation Standards for the runway crossing situation. Those standards describe specific situations and are applicable when the pilots involved are operating on the aerodrome control (ADC) radio frequency. However, the adapted procedure is being used with the pilots involved operating on separate radio frequencies (the ADC and surface movement control frequencies). As one of the preventative risk controls in the procedure has been removed, there is the likelihood that the situational awareness of the pilots involved will be reduced.

The use of the adapted procedure is contrary to the application of separation assurance by controllers. It is also reliant on the accuracy of a controller's expectation of performance of each pilot/aircraft combination despite the provisions of MATS 6.3.1.7. Both pilot and controller performance can vary, as can aircraft performance. Consequently, the inherent surety provided by a separation standard can be reduced due to the uncertainty of such issues as reaction time for a pilot to commence a takeoff after being issued with a take-off clearance or how a controller may perceive a situation.

The awareness of the runway crossing situation by the ADC was a preventative risk control that is subject to human performance limitations. The narrowing of a controller's attention, because of workload or other aspects, during runway crossing situations may lead to a near collision or accident. This is particularly relevant when controllers are involved in a busy or complex traffic sequence and likely to be subject to increased levels of workload and stress. While the investigation was unable to determine whether the narrowing of controller attention was a factor in the incident, the use of a memory prompt or aid by an ADC may minimise the impact of a narrowing of attention during runway crossing situations.

CONCLUSIONS

The investigation highlighted a limitation in the Manual of Air Traffic Services in that there is no standard or procedure applicable to runway crossing situations. The adaptation of standards and procedures for other specific situations has possibly reduced safety when used for runway crossing situations.

SAFETY ACTION

As an outcome from the investigation Airservices Australia has advised the Australian Transport Safety Bureau that it intends to:

- review the use of take-off/landing clearance procedures during runway crossing situations, by aircraft and vehicles, to ensure that aerodrome controllers are using runway standards appropriately
- review runway crossing procedures with a view to assessing the need for a specific runway standard for situations involving aircraft or vehicles crossing a runway during landing/take-off operations
- review the use of memory prompts or aids by tower controllers in situations involving aircraft taxiing across a runway during landing/take-off operations.